(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 427 308 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90202687.1**

(51) Int. Cl.5: **F26B 21/06**, F26B 23/02

(22) Date of filing: **10.10.90**

(30) Priority: **07.11.89 NL 8902754**

(43) Date of publication of application:
15.05.91 Bulletin 91/20

(84) Designated Contracting States:
DE FR GB NL SE

(71) Applicant: **STORK CONTIWEB B.V.**
Wim de Körverstraat 43a
NL-5831 AN Boxmeer(NL)

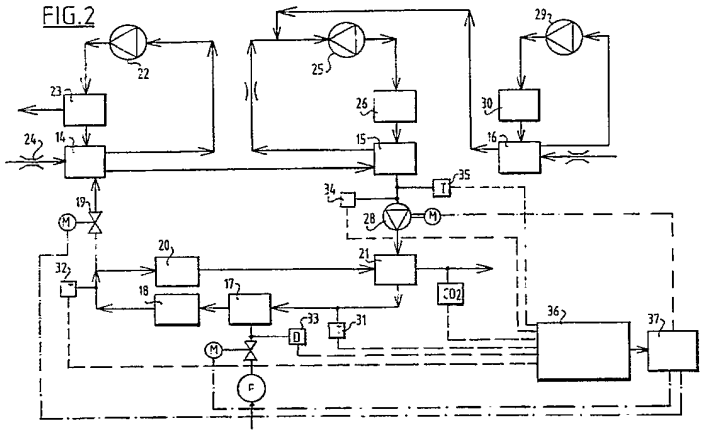
(72) Inventor: **Jacobs, Thomas Gerardus Maria**
Hondsroos 6
NL-5432 GN Cuijk(NL)
Inventor: **de Vroome, Clemens Johannes Maria**
Oeffeltseweg 21
NL-5835 BB Beugen(NL)

(74) Representative: **Hoorweg, Petrus Nicolaas et al**
OCTROOIBUREAU ARNOLD & SIEDSMA
Sweelinckplein 1
NL-2517 GK The Hague(NL)

(54) Control of the concentration of solvents in a dryer.

(57) The invention relates to a method for drying lengths of carrier material which have been printed with ink comprising an evaporable solvent. To maintain the concentration of the solvents evaporating from the printing ink, this concentration has to be determined. As known apparatuses for measuring the concentration are expensive, prone to faults and need regular calibration, the present invention provides a method for calculating that concentration. According to said method the concentration of the evaporated solvents in the gas mixture is determined by measurement of the temperature and flow rate of a mixture to be supplied to the burner (2), and by measurement of the temperature of the gas mixture heated by the burner (2) and by measurement of the flow rate of the fuel supplied to the burner (2). More precisely the concentration is determined by calculation of the increase in heat of the gas mixture in the burner (2), the amount of heat supplied by the burner (2), and in which from the difference thereof the burning heat of the solvents is determined, after which with the known burning value thereof the concentration is determined.

FIG.2



EP 0 427 308 A1

CONTROL OF THE CONCENTRATION OF SOLVENTS IN A DRYER

The present invention relates to a method for drying of lengths of carrier material, which have been printed with an ink comprising an evaporable solvent.

The present invention relates in particular to such a method, in which the lengths are guided through a chamber, a gas mixture heated by a burner is conveyed to that chamber, the gas mixture coming from such chamber is fed to the burner for heating, and a part of the gas mixture coming from the chamber is vented off.

Such a method is known from the Dutch patent application 88.00226.

The venting off of the gas mixture takes place to maintain the concentration of the solvents evaporating from the printing ink by the raised temperature beneath a certain value. Initially, this value is determined by the safety regulations, and secondly this value is determined by the fact, that the circulating gasses can of course not be saturated with solvents as otherwise no evaporation thereof can take place.

The gasses thus vented off carry a considerable amount of heat. From an energetic point of view it is thus important to keep the amount of gasses vented off as small as possible.

In such a method one aims for controlling the amount of gas mixture to be vented off such, that:
- the concentration of the evaporated solvents, generally oils, is kept sufficiently beneath the value, required for safety reasons;
- the concentration is kept on such a value, that printed matter of a good quality is obtained; and
- the amount of gasses vented off is as small as possible.

Generally the second aim leads to a much lower value of the maximal allowable concentration, so that in practice consideration is made between the second and the third aim.

To make this consideration it is necessary to determine the concentration. It is possible to measure the concentration. The known measuring equipment used therefor is expensive and prone to faults, and it has to be calibrated regularly.

The aim of the present invention is to provide a method, in which the concentration of the evaporated solvents in the gasses is determined, and in which the disadvantages, related to direct measurement thereof, are avoided.

This aim is reached, in that the concentration of the evaporated solvents is determined by calculation.

In the calculation of the concentration of the evaporated solvents one departs from some measurements; according to a preferred embodiment of the invention the following values are measured: the temperature and the flow rate of the gas mixture to be fed to the burner, the temperature of gas mixture leaving the burner, and the flow rate of the fuel, feeding the burner.

From the flow rate of the fuel the amount of heat developed by the burner is determined; the burning value of the fuel is known. The flow rate of the gasses coming from the chamber and the temperature rise of the gas mixture having passed the burner caused by the burner, leads to the total supply of heat.

This value is compared with the amount of heat supplied by the burner. From the difference the heat value of the solvents can be determined, from which, with the help of calculated values for the burning value of the solvents, the concentration thereof can be determined.

The invention relates also to an apparatus for executing the methods set out above.

Subsequently, the present invention will be elucidated with the help of the accompanying drawings, in which:

fig. 1: is a diagram of a first embodiment of the present invention; and

fig. 2: is a diagram of a second embodiment of the present invention.

In the embodiment shown in fig. 1 the lengths of material to be dried are fed through a chamber 1. In this chamber 1 sprayheads are not depicted in the drawing are used, which make the carrier material dry. For supplying a heated gas mixture, commonly air, a burner 2 has been provided, which is connected with the chamber 1 via a channel 5, in which a ventilator 3 has been located. The gas mixture emerging from the chamber 1 is fed to the burner through a channel 4.

Also a by-pass 40 passing the burner has been provided for the gas mixture. To burn the solvents present in the gas mixture as far as possible in the burner, the temerature of the burner must be rather high, for instance about 800 ° C. When a gas mixture with this temperature would be fed to the lengths to be dried, these would burn. To avoid this the by-pass 40 with a controlling valve 41 has been provided, so that the heated air is mixed with cold air.

Thus a closed system is present, within which the gas mixture travels, which gas mixture exerts its drying effect on the lengths of material fed through the chamber 1, and which thus cooled down is partly heated by the burner 2, is being mixed with the not-heated air, and is fed to the chamber 1 by means of the pump 3.

Of course a fuel supply pipe 6 has been pro-

vided for supplying fuel to the burner 2. By evaporation of the solvents present in the ink, the concentration thereof in the circuit thus described is raised. For venting of gasses from the circuit a venting pipe 7 has been provi ded, which is connected to the channel 5 by means of a volve 8.

This decreases the amount of circulating gas, so that also means have to be provided for the supply of new gas. Therefore it is possible to provide the supply channel not depicted in the drawing for supplying gas, for instance air from outside; it is also possible to supply a part of the burned gasses of the burner to the gas circuit. This considerably enlarges the energetic efficiency.

To control the amount of gasses to be vented as accurate as possible, it is of importance, that the concentration of the evaporated solvences present in the gasses is determined very accurately.

In the present invention this is provided by the application of a temperature measuring element 9, which measures the temperature of the gas mixture to be fed to the burner 1. Further a flow rate measuring element 10 has been provided from measuring the flow rate of the gas mixture to be supplied to the burner 1.

Further a temperature measuring element 11 is present for measuring the temperature of the gas mixture leaving the burner 2, and in the fuel supply pipe 6 a flow rate meter 12 has been provided for measuring the flow rate of the fuel. The signals from these measuring elements are fed to a control element 13, which supplies a control signal to the controlable valve 8 through a signal lead 14.

The calculation of the concentration of the evaporated solvents takes place as follows: from the fuel flow rate the amount of heat which is supplied by the burner 2 to the passing gasses, is determined.

Then, by measurement of the flow rate of the gas mixture and of the temperature rise thereof, the increase of heat content of the gasses in the burner is determined. This value is compared with the heat supplied by the burner, which can be calculated from the flow rate of the fuel and the burning value thereof. From the difference of these values and the known burning value of the solvents, the concentration thereof can be calculated. The assumption is made that the solvents burn completely.

With the help of this concentration, the position of the valve 8, and thus the amount of gasses to be vented is determined. When instead of a burner an electric heating element is provided, it is also possible to measure the heat developed by such an element, and to execute an equivalent calculation.

In the embodiment depicted in fig. 2, the invention is integrated in a dryer with a complicated configuration. This dryer comprises three zones, first zone 14, in which the carrier material is preheated, a second zone 15, in which the carrier material is dried; and a third zone 16, in which the carrier material is cooled down.

The features of the invention are in particular applicable to the first and the second zone. The gas mixture emerging from the burner 17 is supplied to a first zone 14 via a first chamber 18 and a valve 19. A part of this gas mixture is supplied to a heat exchanger 21 via a second chamber 20, and is subsequently vented outwardly. In the heat exchanger 21 the gas mixture fed to the burner 17 is heated to obtain an efficiency as high as possible.

The gas mixture arriving in the second zone 14 is fed to sprayheads 23 with the help of a first ventilator 22 to heat the carrier material. Also fresh air is fed to said first zone via the entrance slit 24 for the carrier material.

A part of the gas mixture just developed goes to the second zone, from which it is guided to a second array of sprayheads 26 via a second ventilator 25. The gas mixture emerging from this zone is partially supplied via a third ventilator 28 to a heat exchanger 21 and subsequently to the burner 17.

In the third zone 16 fresh air from outside is supplied with the help of a fourth ventilator 25, which is sprayed to the carrier material by means of an array of sprayheads 30, which makes the carrier material cool down. Extra air from the third zone 16 is supplied to second zone 15, and indeed at the entrance at the second ventilator 25.

Thus the circuit of the gas mixture is closed. As appears from the diagram above, the venting of the gas from the system can be control led through the second chamber 20 and the heat exchanger 21, which is controlled by the valve 19 together with the flow rate of the ventilator 28.

According to the invention the flow rate of the ventilator 28 is set such, that in the gas circuit a desired concentration of evaporated solvents is maintained. Also in this case this concentration is determined by measurement of the temperature of the gasses supplied to the burner by the temperature measuring element 31, the measurement of the gasses having left the burner 17 in the first chamber 18 by means of the temperature measuring element 32, the measuring of the flow rate of the fuel by means of the flow rate meter 33, and the measurement of the flow rate of the ventilator 28 with the flow rate meter 34.

Also the temperature of the gasses which are supplied to the heat exchanger 21 is measured with the help of a temperature meter 35. This temperature is used for measuring the flow rate of the mass of the gas mixture from the flow rate of the volume thereof; this specific heat is reversed proportional with the temperature. The signals com-

ing from these measuring elements are supplied to a control element 36. This control element determines the concentration of the evaporated solvents from the measured values on a equivalent way as in the first embodiment.

The control element 36 supplies a signal to a steering element 37, which supplies signals to the control valve 19 for determining the temperature of the dryer, the motor 38 of the ventilator 28 and the motor of the fuel valve 39. Thus the relevant values can be adapted, so that an energy system is obtained with the correct properties. of course the values thus obtained can be applied to control all the parameters in the system. This allows to control the supply of fuel just as the flow rate of the ventilator 28.

Claims

1. Method for drying of lengths of carrier material, having been printed with an ink comprising a evaporable solvent, in which the lengths are fed through a chamber, a gas mixture heated by a burner is supplied to the chamber, the gas mixture coming from the chamber is supplied to the burner for heating, and the part of the gas mixture coming from the chamber is vented outwardly, in which the amount of gas mixture to be vented is determined in depence of the concentration of evaporated solvents in the gas mixture, **caracterised in**, that the concentration of the evaporated solvents is determined by calculation.

2. Method according to claim 1, **caracterised in**, that the concentration of the evaporated solvents in the gas mixture is determined by measurement of the temperature and the flow rate of a mixture to be supplied to the burner, and by measurement of the temperature of the gas mixture heated by the burner, and by measurement of the flow rate of the fuel supplied to the burner.

3. Method according to claim 2, **caracterised in**, that the concentration is determined by calculation of the increase in heat of the gas mixture in the burner, the amount of heat supplied by the burner, and in which from the difference thereof the burning heat of the solvents is determined, after which with the known burning value thereof the concentration is determined.

4. Method according to claim 2, **caracterised in**, that the gasses to be vented are vented after having passed the burner.

5. Method according to claim 4, **caracterised in**, that the gasses to be vented are supplied through a heat exchanger before venting.

6. Dryer for drying printed lengths of carrier materials comprising:
a chamber, through which the lengths of carrier material are fed;
a supply channel for supplying a heated gas mixture to set chamber;
a venting channel for venting a the gas mixture from the chamber having executed the drying process;
a heater for heating the gas mixture having executed the drying process; and
means for venting a part of the gas mixture from the circuit, **caracterised in**, that a control element has been provided for controlling the amount of gas mixture to be vented from the circuit in dependence of the concentration of the evaporated solvents.

7. Dryer according to claim 6, **caracterised in**, that the concentration of the solvents is determined by measurement of the temperature and of the flow rate of the gas mixture supplied to the burner, by measurement of the temperature of the gas mixture heated by the burner, and of the flow rate of the fuel, and by calculation of the burning heat supplied by the burner to the gas mixture, with evaporated solvents, and calculating from the difference the heat value of the evaporated solvents, after which with the help of the supposed to be constant burning value thereof the concentration is determined.

8. Dryer according to claim 7, **caracterised in**, that the control element serves such, that the flow rate of the gas mixture supplied to the burner and the flow rate of the fuel are controlled also in dependence of the calculated concentration of the solvents.

9. Dryer according to claim 7 or 8, **caracterised in**, that a heat exchanger has been incorporated before the burner, to which at least a part of the gasses to be vented are supplied for delivering the heat, and that also the temperature of the gasses supplied to the heat exchan ger to be heated are measured.

10. Dryer according to one of the claims 6-9, **caracterised in**, that a by-pass passing the burner for the gas mixture has been provided

11. Dryer according to one of the claims 6-10, **caracterised in**, that the gasses supplied to the chamber are sprayed to both sides of the path to be traveled over by the lengths of material.

12. Dryer according to claim 11, caracterised in, that the chamber has been divided in two compartments, in each of which a number of sprayheads and ventilators connected therewith has been located.

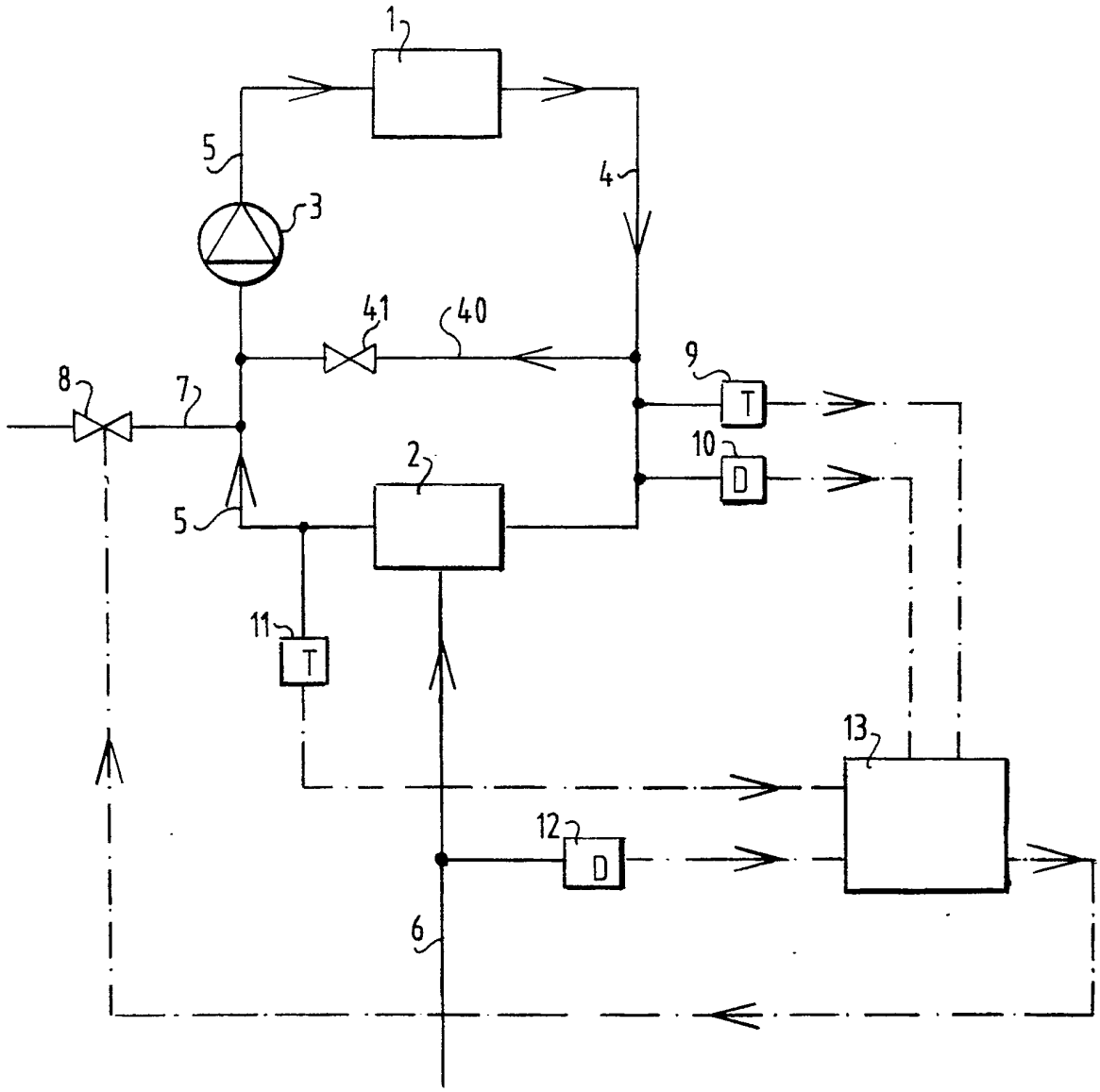


FIG.1

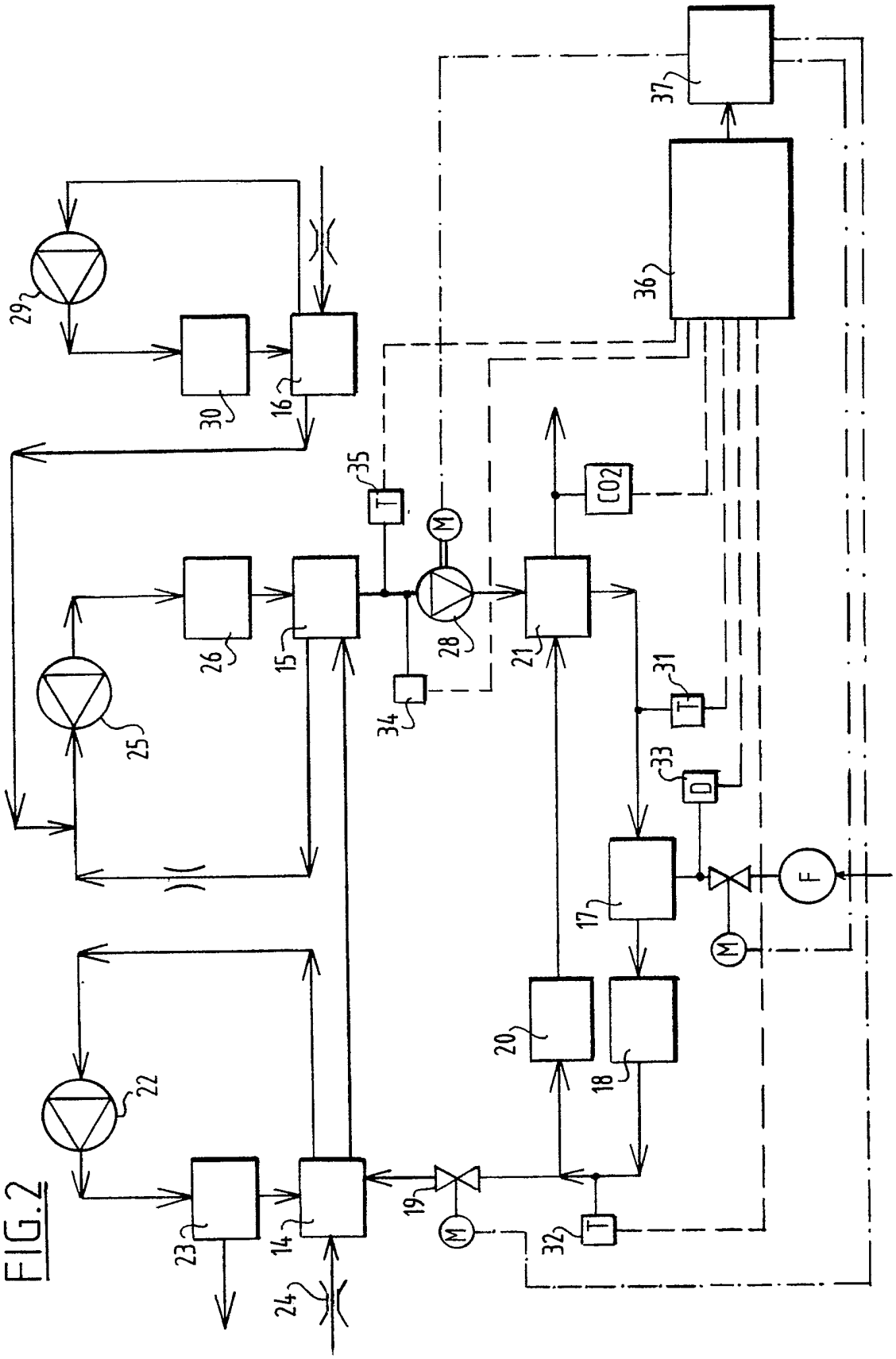

37
36
29
30
16
35
T
M
CO2
28
26
15
21
31
34
25
33
D
17
F
M
20
18
22
19
23
14
32
T
24

FIG.2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 20 2687

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X,Y,A	EP-A-0 065 783 (WINDMÖLLER & HÖLSCHER) * page 7, paragraph 3 - page 8, paragraph 2; figure 4 *	1,4,6,10, 3,2,7,9	F 26 B 21/06 F 26 B 23/02
Y,A	AU-B-4 243 16 (B & K) * page 7, paragraph 2 * * page 10, paragraph 2 - page 11, paragraph 1; figures 1, 2 *	3,6,7,8	
A,D,A	EP-A-0 326 227 (STORK CONTIWEB) * claim 1; figures 1, 2 & NL-A-8800226 (STORK CONTIWEB) *	11,12	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F 26 B

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	07 February 91	PESCHEL G.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same catagory
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention

E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

PUB-NO: EP000427308A1

DOCUMENT-IDENTIFIER: EP 427308 A1

TITLE: Control of the concentration of solvents in a dryer.

PUBN-DATE: May 15, 1991

INVENTOR-INFORMATION:

NAME	COUNTRY
JACOBS, THOMAS GERARDUS MARIA	NL
DE, VROOME CLEMENS JOHANNES MAR	NL

ASSIGNEE-INFORMATION:

NAME	COUNTRY
STORK CONTIWEB	NL

APPL-NO: EP90202687

APPL-DATE: October 10, 1990

PRIORITY-DATA: NL08902754A (November 7, 1989)

INT-CL (IPC): F26B021/06 , F26B023/02

EUR-CL (EPC): F26B021/06 , F26B023/02 , F26B025/00

US-CL-CURRENT: 34/624

ABSTRACT:

CHG DATE=19990617 STATUS=O> The invention relates to a method for drying lengths of carrier material which have been printed with ink comprising an evaporable solvent. To maintain the concentration of the solvents evaporating from the printing ink, this concentration has to be determined. As known apparatuses for measuring the concentration are expensive, prone to faults and need regular calibration, the present invention provides a method for calculating that concentration. According to said method the concentration of the evaporated solvents in the gas mixture is determined by measurement of the temperature and flow rate of a mixture to be supplied to the burner (2), and by measurement of the temperature of the gas mixture heated by the burner (2) and by measurement of the flow rate of the fuel supplied to the burner (2). More precisely the concentration is determined by calculation of the increase in heat of the gas mixture in the burner (2), the amount of heat supplied by the burner (2), and in which from the difference thereof the burning heat of the solvents is determined, after which with the known burning value thereof the concentration is determined.